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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report on promoting individual and organizational productivity through practical intelligence discusses the authors' tacit-knowledge framework and some of the experiments done to test the framework. The basic idea behind the experiments is that a critical component to success in organizations is tacit knowledge, or what one learns on the job that is not explicitly taught and often, not even verbalized. We have done a series of experiments that show, in a variety of jobs and settings, the importance and nature of tacit knowledge. These experiments examined the role of tacit knowledge in jobs such as management, teaching, and sales, and looked at the importance of tacit knowledge to students. We found that tacit knowledge tends to increase with experience, although it is what one learns from experience rather than the experience itself that is critical. We also found that tacit knowledge is unrelated to traditional measures of intellectual abilities, and that it predicts job performance about twice as well as conventional ability tests. Tacit knowledge is important in a variety of occupations and can be measured in ways that are both reliable and valid. The (Continued)						
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# **Promoting Individual and Organizational Productivity Through Practical Intelligence: The Role of Tacit Knowledge in Personal and Organizational Effectiveness**

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PROMOTING INDIVIDUAL AND ORGANIZATIONAL PRODUCTIVITY  
THROUGH PRACTICAL INTELLIGENCE: THE ROLE OF TACIT  
KNOWLEDGE IN PERSONAL AND ORGANIZATIONAL EFFECTIVENESS

Practical (or everyday) intelligence seems to be a different kettle of fish from academic intelligence. There are any number of ways in which we see this difference in our everyday lives. We see people who succeed in school and fail in work, or who fail in school but succeed in work. We meet people with high intelligence-test scores who seem brain-damaged in their social interactions. And we meet people with low test scores who can get along effectively with practically anyone. The research literature confirms our everyday impressions. There just doesn't seem to be much relation between people's academic and practical skills (see Sternberg & Wagner, 1986). For example, Lave, Murtaugh, and de la Rocha (1984) have found that women who can compute effectively in a supermarket price-comparison situation may not be able to compute effectively in a paper-and-pencil arithmetic test of isomorphic operations. Ceci and Liker (1986) have found that men with low-average IQs can show considerable cognitive complexity in their predictions of winners at the race track. Scribner (1986) has shown that men working in a milk-processing plant, probably not men with stunningly high IQs, can be quite innovative in speeding up their work. And at an operational level, we find that whereas conventional intelligence tests predict school performance at a correlational level that is typically in the .4 to .6 range, prediction of job performance is more typically at about the .2 level (Wigdor & Garner, 1982).

There may be any number of reasons for the difference between academic and practical intelligence, but we would suggest that a major source of this difference is the sheer disparity in the nature of the kinds of problems one faces in academic versus practical situations. Academic problems tend to be (a) formulated by others, (b) well-defined, (c) complete in the information they provide, (d) characterized by having only one correct answer, (e) characterized by having only one salient method of obtaining the correct answer, (f) disembedded from ordinary experience, and (g) of little or no intrinsic interest. Practical problems, in contrast to academic problems, tend to be characterized by (a) the key roles of problem recognition and definition, (b) their ill-defined nature, (c) substantial information seeking, (d) multiple "correct" solutions, (e) multiple methods of obtaining solutions, (f) the availability of relevant prior experience, and (g) often highly motivating and emotionally involving contingencies. Given the differences in the nature of academic and practical problems, it is no surprise that people who are adept at solving one kind of problem may well not be adept at solving problems of the other kind. We therefore might want to seek some construct or set of constructs that would help us frame the difference or differences between the skills needed to solve problems of the two kinds.

This report will be divided into four main parts. First, we will describe the construct of tacit knowledge that motivates all of the work described in the report. Second, we will describe a series of experiments with adults that illustrate the nature, use, and acquisition of tacit knowledge in a variety of careers, including college professors, business executives, and sales people. Then, we will describe experiments done

with college and high school students that show the different levels of tacit knowledge. Finally, we will sum up the main points of our exposition.

### The Construct of Tacit Knowledge

In academic problems, formal knowledge plays a key role. Any number of studies have shown that expertise in solving academic kinds of problems is heavily dependent on the availability and accessibility of formal knowledge (see, e.g., Chi, Glaser, & Farr, 1988). Formal knowledge seems much less relevant to practical problem solving. Formal knowledge will not tell one, for example, what kinds of things one can and cannot say to a supervisor or a teacher, or how one can best budget one's time to get all of one's job-related tasks done, or how one can avoid procrastinating so as to get these tasks done. In non-academic tasks, the key kind of knowledge appears to be informal, or what we call tacit knowledge (Wagner & Sternberg, 1985, 1986; see also Polanyi, 1976). Tacit knowledge is practical know-how that usually is not directly taught or even openly expressed or stated. It is the kind of knowledge that one picks up on a job or in everyday kinds of situations, rather than through formal instruction. For example, knowing how to convince others of the worth of your idea or product is not a kind of knowledge that is likely directly to be taught, but rather the kind of knowledge one is likely to pick up through experience.

We distinguish among three kinds of tacit knowledge: tacit knowledge about managing oneself, about managing others, and about managing tasks. Tacit knowledge about managing oneself refers to knowledge about self-motivational and self-organizational aspects of work-related performance. Tacit knowledge about managing others refers to knowledge useful in work-related interactions with one's subordinates, superiors, and peers. Finally, tacit knowledge about managing tasks refers to knowledge about how to do specific work-related tasks well. We also distinguish between two orientations of tacit knowledge, depending upon the time frame within which the tacit knowledge would be used. The focus of local tacit knowledge is the situation at hand. The focus of global tacit knowledge is on how the situation at hand fits into the bigger picture. Because the three kinds of tacit knowledge are orthogonal to the two orientations of tacit knowledge, it is possible to cross them, yielding six (three x two) categories in all.

Although our focus in this report will be on tacit knowledge--its nature, use, and acquisition--we wish to emphasize that the construct of tacit knowledge fits within a more general theoretical framework for understanding intelligence, namely, the triarchic theory of human intelligence (Sternberg, 1985).

The triarchic theory posits that intelligence can be understood in terms of the application of components of information processing to varying levels of experience, which in turn can serve three functions in real-world contexts: adaptation to existing environments, selection of new environments, and shaping of existing environments to turn them into new environments. Tacit knowledge is used in adaptation to environments, but also in deciding when an environment is unsatisfactory and a new one needs to be sought out (environmental selection) or when the present environment can be shaped into a more nearly optimal one (shaping of the

environment). Thus, tacit knowledge is most relevant to the contextual or practical subtheory of the triarchic account of intelligence: It is the knowledge base that enables us to face the everyday world.

How does one measure tacit knowledge? Wagner and Sternberg (1985) devised a method of presenting scenarios to individuals that depicted the kinds of problems faced by people in a given life pursuit. Examinees make judgments about these scenarios that require them to have and exploit tacit knowledge. Note that our measures are not simply measures of whether or not individuals have tacit knowledge, but measures of whether they have and then can use it. Table 1 shows examples of scenarios measuring tacit knowledge for managing oneself, managing others, and managing tasks.

These scenarios are based on our reading of the literature, personal experience, and personal interviews with people in the various fields we have studied who have displayed high levels of practical intelligence in their work (as determined through a nomination procedure). The interviewees agreed that their ability successfully to negotiate the work environment derived not from high IQ or even what they had learned in school, but from the work-related knowledge that they had picked up and exploited on the job--in other words, what we are calling "tacit knowledge."

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Insert Table 1 about here

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Having described now some of the basic elements of our construct of tacit knowledge and the theoretical framework into which it fits, we shall proceed to describe experiments with adults that have tested and/or expanded our conception of tacit knowledge. Our research is not limited to these experiments, which in fact comprise a small portion of the research we have done. But these experiments illustrate our work. (See enclosed publication list for other studies.)

#### Experiments on the Nature, Use, and Acquisition of Tacit Knowledge in Adults

##### Experiment 1: Academic Psychologists

The goal of this experiment was to construct-validate a theory and test of tacit knowledge for academic psychologists (Wagner & Sternberg, 1985). There were three groups of subjects.

Group 1 consisted of 54 members of the faculty in 20 psychology departments, either in the top fifteen by national rankings or not in the top fifteen. Group 2 consisted of 104 psychology graduate students sampled from the same departments as were the faculty. Group 3 consisted of 29 Yale undergraduates. Each subject received 12 work-related situations, each with from six to twenty response items. For example, one work-related situation described a second-year assistant professor who in the past year had published two unrelated empirical articles, who had one graduate student working with him, and who had as yet had no external source of funding. His goal was to become a top person in his field and to get tenure in his department. Subjects had to rate on a 1 to 9 scale the value of several pieces of advice regarding what he could do in the next two months, given that he didn't have time to follow all of the pieces of advice. Examples of pieces of advice were to: (a) improve the quality of his teaching, (b) write a grant proposal, (c) begin a long-term

Table 1

Scenarios for Measuring Tacit Knowledge

Managing Self

You are concerned that you habitually put off completing disagreeable tasks and wish to improve this aspect of your work-related performance. Upon further examination, you think that your problem is one of procrastination--being unable to start tasks you need to get done on a given day. You have asked for advice about dealing with this problem from several friends in the company who seem to be especially productive when it comes to completing tasks. Write the quality of the following pieces of advice that you have been given:

- \_\_\_\_\_ Wait to begin a given task until you really wish to do it.
- \_\_\_\_\_ Spend some time considering just what it is you dislike about a particular task and then try to change that aspect of it.
- \_\_\_\_\_ Get rid of all distractions (perhaps by taking the task into a conference room) so that there is nothing else you can do but the task you must complete.
- \_\_\_\_\_ Force yourself to begin the day by spending fifteen minutes on the task, in the hope that once you have started you will keep on it.

Managing Others

You have just learned that detailed weekly reports of sales-related activities will be required of employees in your department. You have not received a rationale for the reports. The new reporting procedure appears cumbersome and it will probably be resisted strongly by your group. Neither you nor your employees had input into the decision to require the report, nor in decisions about its format.

You are planning a meeting of your employees to introduce them to the new reporting procedures. Rate the quality of the following things you might do:

- \_\_\_\_\_ Emphasize that you had nothing to do with the new procedure.
- \_\_\_\_\_ Have a group discussion about the value of the new procedure and then put its adoption to a vote.
- \_\_\_\_\_ Give your employees the name and number of the director responsible for the new procedure, so that they may complain to that individual directly.
- \_\_\_\_\_ Promise to make their concerns known to your superiors, but only after they have made a good faith effort by trying the new procedure for six weeks.



Table 1 (continued)

- \_\_\_\_\_ Since the new procedure will probably get an unpleasant response anyway, use the meeting for something else and inform them about it in a memo.
- \_\_\_\_\_ Postpone the meeting until you find out the rationale for the new procedure.

Managing Tasks

You are responsible for selecting a contractor to renovate several large buildings. You have narrowed the choice to two contractors on the basis of their bids and after further investigation, you are considering awarding the contract to the Wilson & Sons Company. Rate the importance of the following pieces of information in making your decision to award the contract to Wilson & Sons:

- \_\_\_\_\_ The company has provided letters from satisfied former customers.
- \_\_\_\_\_ The Better Business Bureau reports no major complaints about the company.
- \_\_\_\_\_ Wilson & Sons has done good work for your company in the past.
- \_\_\_\_\_ Wilson & Sons' bid was \$2000 less than the other contractor (approximate total cost of the renovation is \$325,000).
- \_\_\_\_\_ Former customers whom you have contacted strongly recommended Wilson & Sons for the job.

Note: Examinees rate the quality of each piece of advice on a 1 (low) to 9 (high) scale.

research project that might lead to a major theoretical article, (d) concentrate on recruiting more students, (e) serve on a committee studying university-community relations, and (f) begin several related short-term research projects, each of which might lead to an empirical article.

The main independent variables in the study were tacit knowledge about managing oneself, others, and one's career, as well as group membership. The main dependent variable was the set of ratings to tacit-knowledge test items. As criterion variables against which to validate the tacit-knowledge test empirically, we obtained for the faculty members citation rates and numbers of publications from established reference sources, and we obtained from questionnaire data number of conferences attended within the last year, number of conference papers presented within the last year, distribution of time, academic rank, year of PhD, and level of institutional affiliation (higher or lower). For the undergraduates, we obtained scores on the verbal reasoning section of the Differential Aptitude Test (DAT) (Bennett, Seashore, & Wesman, 1974).

Tacit-knowledge tests were scored by correlating ratings on each item with an index variable for group membership (3=faculty member, 2=graduate student, 1=undergraduate). A positive item-group membership correlation would indicate that higher ratings were associated with more expertise, whereas a negative correlation would indicate the reverse. We found significant positive correlations for the faculty members between tacit-knowledge scores and number of publications (.33), number of conferences attended (.34), rated level of institution (.40), and proportion of time spent in research (.39). We obtained significant negative correlations between tacit-knowledge test scores and proportion of time spent in teaching (-.29) and proportion of time spent in administrative activity (-.41). For the undergraduates, who received the verbal reasoning test, there was no significant correlation between tacit-knowledge and verbal-reasoning scores (-.04). Other correlations were in the predicted direction. Thus, the tacit-knowledge test correlated well with at least some of the criteria against which it was validated, but did not correlate significantly with the standard test of verbal reasoning.

#### Experiment 2: Business Managers

The goal of this experiment was to construct-validate the theory and test of tacit knowledge for business managers (Wagner & Sternberg, 1985). Again, we had three groups of subjects.

Group 1 consisted of 54 managers, 19 of whom were from among the top twenty companies in the Fortune 500, 28 of whom were not in these companies, and 7 who did not indicate their company affiliation. Group 2 consisted of 51 graduate students in five business schools varying in level of prestige. Group 3 consisted of 22 Yale undergraduates. Materials were twelve work-related situations, each with from 9 to 20 response items. The main independent variables were tacit knowledge about managing oneself, managing others, and managing one's career, as well as group membership. The main dependent variable was the set of ratings to the tacit-knowledge items. As criteria against which to validate the tacit-knowledge test, for managers we used level of company (top of the Fortune 500 or not in the Fortune 500), number of years of management experience, number of years of formal schooling, salary, number of employees supervised, and level of job title. Undergraduates took the Differential Aptitude Test, Verbal Reasoning subtest.

Again, we found some significant correlations for the professional group between the tacit-knowledge test and the criteria. Significant correlations were obtained for level of company (.34), number of years of schooling beyond high school (.41), and salary (.46). Other correlations were in the predicted direction. For the undergraduates, the correlation between tacit-knowledge scores and verbal-reasoning ability was not significant (.16), again suggesting that the tacit knowledge test was not merely a fancy conventional intelligence test.

#### Experiment 3: Bank Managers

The goal of this third experiment was to cross-validate the management test on a new sample from a single company and occupation (Wagner & Sternberg, 1985).

Subjects were 29 managers from offices of a local bank. Materials were the same as in Experiment 2. The main independent variables were once again tacit knowledge regarding management of oneself, others, and one's career, whereas the dependent variable was the set of ratings to the tacit-knowledge items. Because we were now using managers from a single institution, it was possible to obtain more detailed criterion information. We obtained percentage of salary increase over the past two years, which in the bank was merit-based; overall performance ratings; ratings for managing personnel; ratings for generating new business; and ratings for implementation of bank policy and procedures.

We found significant positive correlations of the tacit-knowledge test with percentage of salary increase (.48), and with performance ratings for generating new business (.56), and implementation of bank policy and procedures (.39). Other correlations were in the predicted positive direction. Thus, the test successfully cross-validated to a new sample.

#### Experiment 4: Academic Psychologists II

The goal of this experiment was to construct-validate a revised version of the theory of tacit knowledge as well as a revised version of the test (Wagner, 1987). The new theory and test separated global versus local tacit knowledge, and also distinguished between people's conceptions of real versus ideal jobs. In other words, people could have conceptions of what to do in the job they actually had, or they could have conceptions of what to do in the ideal job. The question was whether both of these conceptions would correlate with job performance.

Subjects were again divided into three groups. Group 1 consisted of 91 faculty members in 26 departments of psychology that ranged in rated scholarly quality. Group 2 consisted of 61 graduate students from the same departments. Group 3 consisted of 60 Yale undergraduates. All subjects received twelve work-related situations with from nine to eleven response items. Ratings for both actual and ideal jobs were to be given. The main independent variables in the experiment were three types of ratings (management of oneself, others, and tasks) crossed with two orientations of such ratings (local tacit knowledge and global tacit knowledge). Dependent variables were ratings for actual and for ideal jobs. Criterion variables were rated quality of department, number of citations, and number of publications for faculty members, and DAT verbal-reasoning scores for undergraduates.

In this experiment, a new scoring method was used. A sample of highly practically-intelligent professors was obtained through a nomination process, and tacit-knowledge tests were scored in terms of the distance

( $d^2$ ) of each individual profile from the expert profile. Whereas in the previous experiment mean scores on the tests would not have been meaningful because the scoring procedure was designed to discriminate between groups, in this experiment, mean differences were meaningful.

Mean  $d^2$  values for the three groups were 339 for faculty, 412 for graduate students, and 429 for undergraduates, indicating that, on the average, amount of expertise and tacit knowledge increased with level of experience. Of course, there were exceptions within groups, indicating that what mattered was not merely experience but what one has learned from experience.

Significant correlations were obtained with the criterion variables. Note that now a negative correlation indicates an association between better tacit-knowledge scores and the criteria, because with the distance measure, a better tacit-knowledge score is a lower distance score. For the actual-job ratings, significant correlations were obtained for the faculty members with ratings of department (-.48), number of citations (-.44), number of publications (-.28), proportion of time spent on research (-.41), and number of papers presented (-.21). Significant positive correlations, indicating an association between higher criterion variables and lesser tacit knowledge, were obtained between the tacit-knowledge scores and proportion of time spent in teaching (.26) and proportion of time spent in administration (.19). For the ideal ratings, correlations were generally slightly lower but in the same ballpark. Significant correlations were obtained for rating of department (-.42), number of citations (-.43), and proportion of time spent in research (-.34). We also looked at the intercorrelations of the various scales. The six scales were ratings of (a) oneself-local, (b) oneself-global, (c) others-local, (d) others-global, (e) task-local, and (f) task-global. We found that 13 of the 15 intercorrelations were significant and positive, with correlations generally in the .2 to .4 range. The two non-significant correlations were both in the positive direction. These correlations indicated at least weak "g" for tacit knowledge. In other words, people who scored higher on one of these subscales tended to score higher on the others as well. Thus, although tacit-knowledge scales do not correlate with verbal-reasoning ability, the subscales of the tacit knowledge scales do correlate with each other: People who are higher in one aspect of tacit knowledge also tend to be higher in others.

#### Experiment 5: Business Managers II

The goal of this experiment was to construct-validate the revised tacit-knowledge theory and test for global and local tacit knowledge and for real and ideal jobs with business managers (Wagner, 1987).

Again, there were three groups of subjects. Group 1 consisted of 64 business managers from 31 companies. Of these managers, 26 were from companies in the top forty of the Fortune 500 list; 33 were from companies not on the Fortune 500 list; and 5 were from companies whose identity was not indicated. Group 2 consisted of 25 business graduate students from 7 business schools of varying quality. Group 3 consisted of 60 Yale undergraduates. The main materials were twelve work-related situations. The independent variables were the three contents (ratings of self, others, and tasks) crossed with the two orientations of ratings (local, global). Dependent variables were ratings for actual and for ideal jobs. Criterion variables were salary, number of years of management experience,

level of company, and number of years of formal schooling beyond high school.

Scoring was again done via a distance measure from the prototype of an expert group. Mean scores were 244 for the business managers, 340 for the business graduate students, and 417 for the undergraduates, again indicating greater tacit knowledge as a function of experience. Correlations with criterion variables were somewhat lower than in the previous experiments. For the actual ratings, a significant correlation was obtained for number of years of management experience ( $-.30$ ). Other correlations were in the predicted direction but not significant. For the ideal ratings, significant correlations were obtained with salary ( $-.32$ ) and with number of years of management experience ( $-.27$ ). The correlation with level of company was in the predicted direction, that with years of schooling beyond high school was not (although it was not significant in the other direction). Once again, these six subscales were generally significantly correlated with each other. Twelve of fifteen possible correlations were significant, with values ranging from the .2 level to the .5 level. The other three correlations were in the expected direction. Thus, once again, there was an appearance of a general factor, albeit a weak one, for tacit knowledge.

In this experiment, the same undergraduates took both the academic-psychology and the business-management tacit-knowledge tests. The correlation between scores on the two tests was .58, which was highly significant; thus, it appeared that not only do the subscales of the tacit-knowledge test correlate with each other, but so do scores on two different tests of tacit knowledge. In other words, there appears to be at least some common core of tacit knowledge between disciplines, although the correlation is not high enough to indicate that the tacit knowledge is the same. Rather, there appears to be some tacit knowledge that is the same, and some that is not.

#### Experiment 6: Center for Creative Leadership IDP Business Managers

The goals of this experiment were to construct-validate the tacit-knowledge test against behavior in a managerial simulation, and also to study the incremental validity of the test. In the previous experiments, our criteria were all static. In this experiment, we were able to obtain as a criterion performance in a managerial simulation, which is a more dynamic kind of assessment. We were also able to obtain scores on a wide variety of psychological measures, so that it was possible to determine whether tacit knowledge qualitatively differed from kinds of attributes measured in psychological tests beyond simply the verbal-reasoning ability that we had measured in the prior experiment.

Subjects were 45 participants in the Leadership Development Program (IDP) at the Center for Creative Leadership in Greensboro, North Carolina. Participants were generally mid- to upper-level executives. Materials were nine work-related scenarios, each with ten response items. In addition, we had available from the Center for Creative Leadership scores on a number of psychological tests. The tests included a test of intelligence, the California Psychological Inventory, the Myers-Briggs Type Indicator, the Fundamental Interpersonal Relations Orientation-Behavior (FIRO-B), the Hidden Figures Test, the Kirton Adaptation-Innovation Inventory, a managerial job satisfaction questionnaire, and behavioral assessment data from two managerial simulations. The

independent variables were the various intellectual and personality tests. The dependent variable was performance on the managerial simulations.

The main question was whether in predicting performance on the managerial simulation, the tacit-knowledge test showed statistically significant incremental prediction ( $\Delta R^2$ ) over and above the prediction of other measures. Quite simply, the results were uniformly favorable for the tacit-knowledge test. Values of  $\Delta R^2$  for the tacit-knowledge test in predicting the simulation scores were .32 beyond IQ, .22 beyond CPI combined with IQ, .32 beyond the FIRO-B combined with IQ, .28 beyond field independence combined with IQ, .33 beyond innovation scores combined with IQ, .35 beyond the Myers-Briggs combined with IQ, .32 beyond job satisfaction combined with IQ, and .17 beyond all five predictors reliably individually correlated with the simulation. In other words, even with all reliable predictors entered, the tacit knowledge test still contributed incrementally. All of the above values of  $\Delta R^2$  were statistically significant. Thus, the tacit-knowledge test appears to measure a new construct, not just to rehash other constructs already in the psychological literature.

#### Experiment 7: Salespeople

Our goal in this experiment was to construct-validate a "rules-of-thumb" approach to the understanding and measurement of tacit knowledge in salespeople. In all of the previous experiments, scoring was empirically derived, whether from the directions of correlations between items and an index for group membership, or from comparison between expert and experimental-protocols. We believed that it would be preferable to have a more objective, expert-based scoring scheme for evaluating performance on the tacit-knowledge tests.

In our work in sales, therefore, we decided to measure tacit knowledge by means of the "rules of thumb" that sales people allegedly use in order to optimize their performance. Through interviews with successful salespersons and from reading professional and popular books on sales, we derived a list of rules of thumb, which, according to its dictionary definition, is a "useful principle with wide applicaiton, not intended to be strictly accurate" (Morris, 1978, p. 1134). The rules of thumb were divided into several main categories. For example, one such category was setting sales goals. Examples of rules of thumb under this category were: (a) target sales goals in number of units sold, not dollars; (b) set goals that are measurable and specific; and (c) commit to reaching your sales goals in writing. Another category was handling the customer who stalls. Examples of rules of thumb here would be: (a) play your hunches and ask if you suspect a competitor has entered the picture; and (b) penetrate smoke screens by asking "what if...?" questions. Another category, attracting new accounts, would have as examples of rules of thumb (a) be selective in to whom you direct your promotion efforts, and (b) ask your customers to provide leads. Or handling the competition, another category, would include as rules of thumb (a) build up your product and company rather than tear down your competitor's; and (b) remember that customers buy for their reasons, not yours.

Subjects in the experiment were divided into two groups. Group 1 consisted of 30 salespeople (who sold automobiles, furniture, or houses) with an average of 14 years of selling experience. Group 2 comprised 50

undergraduates at Florida State University. Each subject received eight work-related scenarios, with eight to twelve response items constructed via a rules-of-thumb approach. Four scenarios related to global tacit knowledge and four to local tacit knowledge. Some of the response items were constructed so that they accurately represented the rules of thumb, whereas others represented weakened or slightly distorted versions of them. Subjects rated the quality of the items on a 1 (extremely bad) to 9 (extremely good) scale. A sample item of global tacit-knowledge for sales appears in Table 2. We were interested in the extent to which subjects rated higher the items that represented the actual rules of thumb versus items that represented distorted versions of these rules. Undergraduates also received the DAT verbal reasoning subscale.

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Insert Table 2 about here

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Two kinds of tacit knowledge are assessed by the measure. Local tacit knowledge refers to practical knowledge that is useful in the short-term accomplishment of the specific sales task at hand, particularly in handling an ongoing personal sales situation. An example of this kind of tacit knowledge is knowing what to do when a customer begins to stall. Global tacit knowledge refers to practical knowledge that is useful in attaining long-range objectives, particularly in maximizing the number of future sales opportunities.

The main independent variables in the experiment were local versus global tacit knowledge, and membership in the salesperson versus undergraduate groups. The main dependent variable was the set of responses to the tacit-knowledge test.

We found that scores on the tacit-knowledge test improved with experience for both local and global tacit knowledge. For local tacit knowledge, the mean for salespeople was 99, versus 74 for undergraduates. For global tacit knowledge, the mean for salespeople was 110 versus 92 for the undergraduates. The total for salespeople was therefore 209 versus 166 for the undergraduates. Thus, people scored higher on the measure with more experience in sales. We also found that whereas global tacit knowledge did not correlate (.05) with the DAT verbal reasoning subsection, local tacit knowledge did (.40). For the first time, then, we obtained a significant correlation between tacit-knowledge scores and verbal reasoning ability, but only for local tacit knowledge.

#### Experiment 8: Salespeople II

The goal of the experiment was the external validation of the tacit-knowledge theory and test for salespeople with measures of actual performance in sales.

Subjects were divided into two groups. Subjects in the first group comprised 48 life-insurance salespeople with an average of eleven years of selling experience. Subjects in the second group consisted of 50 undergraduates at Florida State University with no sales experience. The main materials were the tacit-knowledge measure for sales (from Experiment 7) and, for undergraduates, the DAT verbal-reasoning test. The main independent variables were local versus global tacit knowledge, and membership in the salespeople versus undergraduate groups. The main dependent variable was the set of tacit-knowledge scores. We also had criterion variables against which to validate the tacit knowledge test:

Table 2

Example of Global Tacit Knowledge Item for Sales

You sell a line of photocopy machines. One of your machines has relatively few features and is inexpensive, at \$700, although it is not the least expensive model you carry. The \$700 photocopy machine is not selling well and it is overstocked. There is a shortage of the more elaborate photocopy machines in your line, so you have been asked to do what you can to improve sales of the \$700 model.

Rate the following strategies for maximizing your sales of the slow-moving photocopy machine.

- A. Stress with potential customers that although this model lacks some desirable features, the low price more than makes up for it.
- B. Stress that there are relatively few models left at this price.
- C. Arrange as many demonstrations as possible of the machine.
- ...
- J. Stress simplicity of use, since the machine lacks confusing controls that other machines may have.

Note: Subjects rated items on a 1 (extremely bad) to 9 (extremely good) scale.



number of years with the company, number of years in sales, number of yearly quality awards, 1985 sales volume, 1986 sales volume, 1985 premiums, 1986 premiums, college background, and business education.

Once again, tacit knowledge increased with level of experience. The respective scores for undergraduates and salespersons were, for local tacit knowledge, 73 and 94; for global tacit knowledge, 92 and 112; and for total score, 165 and 206. Thus, again, salespersons did better than did undergraduates. We found some correlations between our tacit-knowledge test and the criterion variables. For total score, significant correlations were obtained with number of years with the company (.37), number of years in sales (.31), number of yearly quality awards (.35), and business education (.41). However, it turns out that local and global tacit knowledge did not contribute equally to these correlations. For local tacit knowledge, significant correlations were obtained with only three of the variables: number of years with the company (.23), number of yearly quality awards (.28), and business education (.35). For global tacit knowledge, however, significant correlations were obtained with seven criterion variables: number of years with company (.32), number of years in sales (.28), number of yearly quality awards (.25), 1985 sales volume (.37), 1986 sales volume (.28), 1985 premiums (.26), and 1986 premiums (.29). For the undergraduates, once again, local tacit knowledge correlated significantly with the DAT verbal (.25), whereas global tacit knowledge did not (-.02). Thus, the kind of tacit knowledge that correlated significantly with the ability test showed substantially lower correlations with the sales criteria than did the kind of tacit knowledge that did not correlate with the ability test. Once again, then, practical intelligence seems to be something qualitatively different from academic intelligence as measured by conventional tests.

#### Experiment 9: Salespeople III

In a third experiment, the measure of tacit knowledge about sales was given to three samples: 91 college undergraduates with no sales experience; 34 adults from the community with no sales experience; and 36 salespersons. The goal of the experiment was to check the reliability of the inventory and further to validate the inventory.

Internal-consistency reliability provides an estimate of content sampling--the degree to which each item is measuring the same construct. Cronbach's Alphas were calculated for a group of 80 individuals, 30 salespersons and 50 undergraduates. The reliability coefficients were .84, .77, and .68 for Total, Local, and Global scores, respectively. For a second group of individuals, consisting of 48 life-insurance salespersons and 50 undergraduates, reliability coefficients of .82, .71, and .70 were obtained for Total, Local, and Global scores, respectively. These results indicate satisfactory internal consistency reliability.

Test-retest reliability provides an estimate of time sampling--the degree to which scores obtained on one occasion predict scores obtained on a second occasion. The college undergraduate normative sample was given the measure on a second occasion, with a test-retest interval of one month. The test-retest reliability coefficients, .62 for total score, .53 for the local tacit knowledge score, and .63 for the global tacit knowledge score, indicate that there is sufficient test-retest reliability for each score.

Evidence of the validity of the inventory was obtained in three ways. The first was to examine the success with which the inventory could differentiate individuals with sales experience from comparable individuals without sales experience; the second was to examine correlations between performance on the inventory and a measure of verbal reasoning ability to establish that the inventory was not simply a disguised IQ test; the third was to examine correlations between performance on the inventory and measures of career performance in sales.

Means and standard deviations of the inventory scores are presented for the three normative groups in Table 3.

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Insert Table 3 about here

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These results support the discriminant validity of the inventory. The means of the salesperson group were reliably higher than those of the community and undergraduate groups. When the Local and Global subtest scores were used to classify cases in a discriminant analysis, 92.1% of cases were correctly classified for salesperson and undergraduate samples, and 83.8% of cases were correctly classified for community and salesperson samples.

The undergraduate sample was given the DAT Verbal Reasoning subtest so that the correlation between verbal ability and tacit knowledge could be examined. The correlations between the Differential Aptitude Test and the inventory scores were not reliably different from zero for Local (.06), Global (-.09), and Total (-.02) scores. This result indicates that the inventory is not simply a fancy IQ test, and is measuring something other than general verbal ability.

#### Experiment 10: Tacit Knowledge in College Students

Our main goals in the experiment were (a) to identify the tacit knowledge necessary for success as a college student, (b) to compare tacit knowledge for students at different points in their college careers, (c) to assess the role of tacit knowledge in college-student success, (d) to begin construct validation of a tacit-knowledge inventory for college students.

In a prestudy, 50 Yale college students replied to the question: "What does it take to succeed at Yale that you don't learn from textbooks?" The results of this prestudy were used to form a tacit-knowledge inventory for college students.

Subjects in this experiment were 53 Yale college students. Of these subjects, 18 were male and 35 were female. They were divided among classes: 18 freshmen, 3 sophomores, 9 juniors, and 23 seniors.

The main materials were the tacit knowledge test for college students. It consisted of fourteen situations, each with associated response options to be rated on a 1 - 9 scale.

The items were similar in spirit, but different in content from those described earlier. For example, one described the subject as enrolled in a large introductory lecture course. The requirements consisted of three term-time exams and a final. Subjects were asked to rate how characteristic it was of their behavior to spend time doing various activities, such as (a) attending class regularly, (b) attending optional weekly review sections with a teaching fellow, (c) reading assigned text chapters thoroughly, (d) taking comprehensive class notes, and (e) speaking with the professor after class and during office hours. Another

Table 3

Means (and Standard Deviations) of Inventory Scores  
In Experiment 3

SCORE	COMMUNITY	SALESPERSON	UNDERGRADUATE
Local	80.64 (10.49)	96.51 (8.33)	78.35 (8.57)
Global	96.15 (8.33)	108.97 (8.46)	91.63 (9.22)
Total	176.79 (18.17)	205.49 (13.05)	169.98 (12.82)

example of an item would require students to rate how important they believed the average professor considered various activities to be for a student. Examples of such activities would be (a) making an effort to speak with the professor before or after class, (b) meeting with the professor during office hours, (c) completing work ahead of schedule—handing work in early, (d) attending class regularly and arriving on time, (e) writing especially creative and unusual papers, (f) getting high grades on exams, and (g) getting high grades on papers.

The criterion measures in this study were two main indices: an academic index and an adjustment index. The academic index was a composite of high school GPA, college CPA, SAT scores, and CEEB achievement test scores. The adjustment index was a composite of a measure of happiness in college, a measure of self-perceived success in college, a measure of self-perceived success in using tacit knowledge, a measure of the extent of benefit each subject had experienced from learning tacit knowledge, and a measure of the rated closeness of the college to the subject's ideal college. The main independent variables were tacit knowledge scores, year in college, and gender. The main dependent variables were the composite academic and adjustment indices.

The academic and adjustment indices, the main dependent variables in the study, were uncorrelated ( $-.09$ ). Perhaps embarrassingly, the correlation between year at Yale and the adjustment index was negative and significant ( $-.43$ ). Thus, subjects' self-perceived adjustment declined with number of years in the college.

A number of items showed significant correlations with the academic index: perceived importance of maintaining a high GPA (.42), doing extra reading and school work not specifically assigned (.27), not attending optional weekly review sections with a teaching fellow (.31), not skimming required reading the morning before class (.37), not preparing a brief outline of points to raise in class discussion (.31), not helping friends with their assignments (.34), not behaving consistently from situation to situation (.25), finding it uncharacteristic to accept pressure and stress as parts of life (.30), finding it uncharacteristic to stand up for oneself (.34), and its being uncharacteristic to play a sport or exercise regularly (.45).

In general, a different set of items correlated significantly with the adjustment index: beliefs that professors value a clear, direct writing style, good organization of thoughts and ideas, and creative or unusual ideas (.38); beliefs that professors value papers that bring in outside interests or material (.27); beliefs that it is important sometimes to take on too many responsibilities at once (.31), seeking advice from several faculty in addition to one's own professors (.31), taking classes that permit occasional absences (.36), being positive and looking on the bright side of life (.42), not being intimidated (.33), being flexible (.27), maintaining a strong sense of confidence and independence (.37), not worrying unnecessarily or destructively (.31), knowing how to make oneself happy (.32), and not letting small disappointments affect one's long-term goals (.29).

We obtained some rather interesting gender differences. Males rated higher than females in three items: belief that professors value funny and entertaining papers, downplaying the seriousness of cheating, and worrying less. Females rated as higher than males: taking comprehensive

class notes, believing that professors value papers that express special interests and enthusiasms, trying to figure out what makes them happy, thinking about what they are able to do best, trying to discover and understand limitations, and cultivating a sense of responsibility and commitment. The results were very much in line with Gilligan's (1982).

Comparing items that freshmen rated higher than seniors with items that seniors rated higher than freshmen, one might conclude that students become somewhat more cynical over time. Freshmen rated higher than seniors items such as believing that professors value papers with no typographical or grammatical errors, with creative ideas and unusual ideas, with mention of outside interests, with accurate and thorough references, and with a demonstration of effort and motivation. Seniors rated higher than freshmen items indicating that they believe professors value students who get high grades and that they are likely to ask forgiveness if they are caught cheating.

Using relatively small sets of items from the tacit-knowledge scale, we were able to obtain fairly good prediction of both the academic and the adjustment indices. With four items, the overall  $R^2$  with the academic index was .43. The four items were: not preparing an outline of points to raise in class discussion, maintaining a high GPA, not helping friends with assignments, and not playing a varsity or intramural sport. For the adjustment index, the  $R^2$  was .63. The six items contributing significantly to this prediction were: believing professors value a clear, direct writing style; maintaining a strong sense of confidence and independence; standing up for oneself; sometimes taking on too many responsibilities at once; seeking advice from faculty in addition to the instructor of the course; and taking classes that permit occasional absences. In sum, then, tacit knowledge predicts both academic performance and adjustment in college, and thus is important not only in occupational settings, but in school settings as well. To succeed in school, one needs not only formal knowledge, but informal or tacit knowledge.

#### Experiment 11: Acquisition of Tacit Knowledge

The goal of the experiment was to demonstrate that tacit knowledge is acquired through three knowledge-acquisition components specified by the componential subtheory of Sternberg's (1985) triarchic theory of human intelligence: selective encoding, selective combination, and selective comparison. Selective encoding involves distinguishing relevant from irrelevant information in the course of learning new material. Selective combination involves putting the relevant information together in order to form a whole, unified cognitive structure. Selective comparison involves drawing upon past information relevant to the present in order to facilitate learning of new information.

Subjects were divided into five groups: two control groups and three experimental groups. In Group  $C_1$ , a control group, 15 college students received as a pretest and a posttest the tacit-knowledge measure for sales, with no intervening treatment. In Group  $C_2$ , a second control group, 15 college students received the tests as well as a tacit-knowledge acquisition task with no cuing to help them identify or use relevant information. In Group  $E_1$ , an experimental group, 15 college students received the tests and also the acquisition task with selective-encoding cuing. Relevant information for acquisition of tacit knowledge was

highlighted and the relevant rule-of-thumb provided. In Group E<sub>2</sub>, another experimental group, 15 college students received the tests and also the acquisition task with selective-combination cuing. Relevant information was highlighted, the relevant rule-of-thumb was given, and a note-taking sheet with the appropriate categories was given to subjects in order to help them combine information. In Group E<sub>3</sub>, the third experiment group, 15 college students received the tests and also the acquisition task with selective comparison cuing. This cuing was an evaluation that had been completed by a "predecessor" in the company. The idea was that they could use the predecessor's performance to facilitate their own. Relevant information was highlighted and rules-of-thumb were also given to people in this group.

The main materials in the experiment were the tacit-knowledge test for sales and the tacit-knowledge acquisition task. In the task, subjects took the role of a personnel manager whose immediate job was to read the transcripts of three job interviews with applicants for sales positions in his company. The experimenter asked the subjects to evaluate each applicant's ability to manage themselves, to handle the tasks and problems that arise in sales positions, and to handle business relationships with customers, peers, and superiors (i.e., managing oneself, managing tasks, and managing others). The subjects received evaluation forms on which they rated each applicant on each of the categories, gave an overall rating of the applicant, and indicated whether or not the applicant should be hired. In addition, subjects were asked to identify all sentences they had used in the interview protocol in making their evaluations, to indicate the category of information that was relevant (managing oneself, managing tasks, managing others), and to indicate whether the information in each sentence was positive or negative with respect to their decision.

The main independent variable in the experiment was group assignment. The main dependent variables were scores on the acquisition task and difference scores for the tacit-knowledge posttest minus the tacit-knowledge pretest. On the acquisition task, there were three types of scores: (a) hit, that is, the total number of relevant sentences identified as relevant (plus an additional point for each correct assignment of positivity versus negativity of the information); (b) miss, that is, the total number of relevant sentences not correctly identified as such; and (c) false alarm, that is, the total number of relevant sentences identified as relevant. Subjects were instructed to take the role of the manager who is evaluating three possible candidates for sales positions in the company. The manager can hire none, one, two, or all of the candidates. The important thing is to hire only those persons who have the most potential for being good salespeople in the company. The subjects were first given a two-page description of the company to read. Then they were given transcripts of the three job interviews. They were instructed to read through all three interviews before they did their evaluations.

In the tacit-knowledge acquisition task, we did a MANOVA with the experimental group as the independent variable and hits, misses, and false alarms as the dependent variables and found that there was an overall difference among the four groups. The second control group performed significantly worse than the three experimental groups. The mean number of hits was lowest in the second control group (C<sub>2</sub>) (27.7), and the

number of misses and false alarms was highest in this group (90.5 and 54.3 respectively). Among the experimental groups, the selective-combination group did the best: 70.2 hits, 49.9 misses, 21.3 false alarms. Performance of the selective-encoding and selective-comparison groups was comparable, and lower than the selective-combination group but higher than the control group: 45.5 hits, 74.7 misses, and 28.3 false alarms for the selective-encoding group ( $E_1$ ), and 41.1 hits, 78.8 misses, and 19.8 false alarms for the selective-comparison group ( $E_3$ ).

We also looked at posttest minus pretest difference scores on the tacit-knowledge tests for each of the groups. Group  $C_1$  (the control group with no experimental task) showed the least gain, with a mean difference score of 3.5. Group  $C_2$  did better, with a mean of 7.7. Group  $E_3$ , the selective-comparison group, did slightly better at 9.3, followed by Group  $E_1$  at 16.8 and  $E_2$  at 19.7. Thus,  $C_1$  was the worst,  $C_2$  marginally worse than the other groups, and  $E_1$  and  $E_2$  better than the rest. These results suggest that the selective-comparison manipulation was the weakest of the three, but that the selective-encoding and selective-combination manipulations were quite successful in inducing learning of tacit knowledge for sales.

Tacit knowledge is an important product of practical reasoning. In the following set of studies, we explored the processes of practical reasoning using an inductive reasoning task in social and practical domains.

#### Experiment 12: Processes of Practical Induction in the Social Domain

We developed an inductive reasoning task for the social domain which is similar to concept identification tasks in that subjects are presented a set of cases, about which they make some judgment, and then use feedback about the accuracy of their judgment to improve their performance on subsequent cases. The task consisted of problems, each of which was a set of episodes in the life of a fictitious main character. The main characters were given names.

Unbeknownst to subjects, the main characters' behavior was governed by one, often defining, behavioral characteristic: extrovert, quitter, sensitive, optimistic, introvert, irresponsible/forgetful, adventurous, aggressive, ambitious, and self-centered. These characteristics were adapted from Rosenberg, Nelson, and Vivekananthan (1968), and were chosen to represent both positively and negatively valued characteristics.

The episodes of each problem presented a brief description of a situation that concluded with a choice faced by the main character. The following example is from "aggressive" Jane's story:

The next day, Jane went to the store to spend some of her allowance. There were a lot of neat things and Jane had a hard time deciding what to buy. She was trying to decide between a Rambo-style squirt gun and a set of paints. Which one do you think she chose, the squirt gun or the paints?

After the first episode, each subsequent episode in a story began with a statement indicating what the main character chose in the previous episode. For example, the next episode in Jane's story would begin with, "Jane bought the squirt gun."

The inductive reasoning problems were presented to fourth-grade, seventh-grade, and undergraduate students. The fourth-graders responded orally; the seventh-grader and undergraduates responded in writing. For each episode, subjects (a) predicted what the main character would do, (b) provided a reason that justified their prediction, (c) indicated what they

would choose to do in the situation, and (d) justified their choice. Undergraduates were not asked to tell what they would choose to do because it did not appear appropriate to ask them to do so.

Performance was scored by giving a point for each correct prediction, yielding a maximum possible score of 70 points (10 problems times 7 episodes per problem). A three-point scale was used to score subjects' reasons for their predictions: a 0 was given for a reason unrelated to the defining behavioral characteristic (e.g., for the defining behavioral characteristic of extrovert, "She might be mad"); a 1 was given for an action, feeling, or preference that was congruent with the defining behavioral characteristic (e.g., "She likes to talk"); and a 2 was given for mentioning a trait that was congruent with the defining behavioral characteristic ("She's outgoing"). By scoring predictions and reasons for predictions separately, there were three possible measures of performance on our task: a prediction score, a reasons score, and a combined prediction/reasons score. The results indicated that there were no obvious differences between the ability to make correct predictions and the ability to provide a reason for the predictions, and consequently, there were no differences in the pattern of results as a function of which score was used. We therefore adopted the prediction score as our measure of task performance, considering it to be the most defensible because it avoided the potential problems of unreliability and subjectivity in scoring reasons for predictions.

A pilot study that included a small group of first graders found that the performance of first graders on the task was not above chance. The difficulty level of the task appeared to be appropriate for the fourth and seventh graders. There was, however, an apparent ceiling effect for undergraduates. Prediction scores improved across grade levels: fourth graders ( $M = 42.9$ ,  $SD = 6.8$ , range = 33 to 57); seventh graders ( $M = 51.3$ ,  $SD = 8.5$ , range = 37 to 64); undergraduates ( $M = 60.9$ ,  $SD = 2.9$ , range = 54 to 66).

The group means were in the expected order and reliably different from one another, which indicates that performance improved across grade levels as expected. A reliable linear effect of trial position indicates that performance improved across episodes in a story as a consequence of learning, and a reliable quadratic effect of trial position indicates that this improvement was greater for earlier episodes than for later ones. A reliable group-by-linear trial interaction indicates that there were increasing rates of improvement across grade levels, and a reliable group-by-quadratic interaction indicates that the same was true for the larger increase in performance across early trials. What differentiated fourth and seventh graders was that the fourth graders reached their maximum level of performance by the second trial, whereas the seventh-grade students continued to improve. The undergraduate students were more like the fourth-grade students than the seventh-grade students in that they did not show much improvement after the second trial either, but unlike the results for fourth-grade students the leveling off of performance for the undergraduates after the second trial appears to reflect their reaching a ceiling on task performance.

We hypothesized that subjects might use knowledge about what they would do in trying to understand the behavior of others. Knowledge about what they would do was operationalized by asking our fourth- and seventh-grade subjects what they would do if given the choice faced by the main character. We recognized that our subjects might not always be



completely truthful in their responses to this question (e.g., not admitting they would choose a socially undesirable course of action), but we assumed their accuracy would suffice for testing our hypothesis.

We tested the hypothesis that subjects use knowledge about what they would do in reasoning about the behavior of others by comparing performance on trials for which subjects indicated that they would have made the same choice the character subsequently made, with performance on trials for which subjects indicated that they would have made a different choice from the choice the character subsequently made. There was a large disordinal grade by same-versus-different choice interaction. Fourth-grade students' predictions were more accurate when their self-reports of what they would choose matched what the character chose; seventh-grade students' predictions were more accurate when their self-reports of what they would choose were the opposite of what the character chose. These results held even when the fourth graders and seventh graders were equated for proportion of agreements. Thus, our hypothesis was supported by the fourth-grade data, but was refuted by the seventh-grade data.

We examined correlations between task performance and IQ. Internal consistency reliability estimates (Coefficient Alpha) for performance on the experimental inductive reasoning measure were adequate for fourth graders (.68) and seventh graders (.78), but low for undergraduates (.42), probably a result of the restricted range of scores in the undergraduate group due to ceiling effects on task performance. The means and standard deviations of estimated IQ for the fourth graders ( $M = 104$ ,  $SD = 17.2$ ) and seventh graders ( $M = 102$ ,  $SD = 15.5$ ) were comparable to the standardization sample. The correlations between IQ and task performance were not reliably different from 0 for either the fourth ( $r = -.02$ ,  $p > .05$ ) or seventh ( $r = -.02$ ,  $p > .05$ ) grade groups. The correlation for undergraduates between performance on the induction task and raw score on the Nelsen-Denney also was not reliably different from 0 ( $r = -.13$ ,  $p > .05$ ).

#### Experiment 13: Processes of Induction in Practical Domains

Using an inductive reasoning task in a practical domain, we carried out a series of studies with undergraduate subjects in order to examine systematically the role of biases in inductive reasoning. The materials consisted of problems, each of which began with a brief description of an individual whose stated intention was either to purchase a car, to select an apartment, or to choose a roommate, depending upon which type the problem was. This description was followed by a series of cases. For the "purchasing a car" problem type, each case consisted of a paragraph containing descriptions of a particular car. A sample case for one of the car purchasing problems follows:

This car seats 6 comfortably. It has few options and is priced well below average for a car of this size. It is equipped with a standard transmission. There is adequate luggage space, and the fuel tank is located near the rear axle to avoid rupture. The car has 50,000 miles on the odometer. Insurance rates are low for this model. Labor charges for repair work also are low.

Cases for "selecting an apartment" and "choosing a roommate" problem types consisted of 10 descriptions of an apartment or a roommate, respectively.

The subjects' task for each problem was to predict on a 5-point scale the degree to which the individual who had been described at the beginning of the problem would like the car, apartment, or roommate described

in a given case. Subjects were provided the following scale to use in making their predictions:

+2 = likes [him/her/it] alot; +1 = likes somewhat; 0 = neither likes nor dislikes; -1 = dislikes somewhat; -2 = dislikes a lot.

After making their prediction, the same 5-point scale was used to give subjects the "true" rating, that is, the extent to which the individual really liked what was described by the given case. These true ratings were based on the degree to which the particular example represented the prototype for that particular problem.

The purpose of a first study was to examine the effects of biases on task performance. We manipulated subjects' biases merely by altering a brief description presented at the beginning of each problem of the individual whose ratings were to be predicted. Subjects in a congruent bias condition received a description of an individual that was deemed to be congruent with that particular prototype. An example of such a description for the family-car problem is: "Jim Smith is 43 years old. He is married and the father of four children, ages 5, 7, 10, and 15. The Smiths have two dogs and a cat, and enjoy doing activities as a group." Subjects in an incongruent bias condition received a description of an individual that was deemed to be incongruent with that particular prototype. An example of such a description for the family-car problem is: "Jim Smith is a freshman at UCLA. He is more interested in his social life than in his academic studies. In fact, he chose UCLA over USC because he heard the women were more attractive at UCLA." Finally, individuals in a neutral bias condition received a description that was deemed to be neutral for that particular prototype. An example of such a description for the family-car problems is: "Jim Smith was born in Pennsylvania. His favorite colors are red and yellow. He considers himself to be a good person, though one who has had perhaps more than his share of luck."

The measure of task performance used for the analyses was the absolute value of the difference between predicted and actual rating values. It is important to keep in mind that with such a method of scoring, lower scores indicate higher levels of performance. Totaling scores across nine problems yielded the following group means and standard deviations: congruent bias group 49.9 (9.3); neutral bias group 59.4 (9.3); incongruent bias group 99.9 (13.7). The group means were in the expected order, with performance of the congruent bias group being about double that of the incongruent bias group. Planned comparisons indicated that (a) performance was enhanced in the congruent bias condition relative to the neutral bias baseline condition, and (b) performance was diminished in the incongruent bias condition relative to the neutral bias condition. There was an overall trend of improved performance across trial position, which represents learning, as well as a reliably greater amount of learning over earlier as opposed to later trials. The rate of learning for the incongruent bias group exceeded that of the congruent and neutral bias groups. The results also show that the effects of the bias manipulation did not wash out after the first trial or two, a finding supported by the observation that reliable group differences were found when only data from trials five through ten were analyzed.

As was the case for the induction task for social situations presented earlier, the correlation between task performance and IQ was not reliably different from 0,  $r(82) = -.10$ ,  $p > .05$ . This was also the case when the correlations were calculated separately for the three groups.

#### Experiment 14: Processes of Induction in Practical Domains II

In a second study of induction in practical domains, our goal was to replicate the results of the previous study, and also to include two conditions that were designed to help subjects overcome the detrimental effects of incongruent biases. The materials were the same ones used in the previous study, with the exception that, in order to save time, the roommate selection problems were not included.

There were four between-subjects conditions. Instructions given in congruent bias and incongruent bias conditions were identical to those given to the respective groups in the previous study. Members of an informed condition read the same subject descriptions given to members of the incongruent bias condition; however, they were told that "some of the descriptions of the individuals that have been provided in the problems will be misleading." Our purpose in adding this condition was to determine whether it would be enough simply to alert subjects to the fact that the subject descriptions were designed to mislead them and thereby help them to improve their performance. Members of a bias training condition read the description of the hypothetical individual in the problem and then briefly described (a) the kind of (car/apartment) they might assume the individual is interested in, and (b) the kind of (car/apartment) the individual might be interested in if their assumptions were incorrect.

The replication of the prior results was successful, based on the fact that the performance of the congruent bias group ( $X = 30.4$ ,  $SD = 8.1$ ) was double that of the incongruent bias group ( $X = 72.1$ ,  $SD = 17.5$ ). Three planned comparisons were used to analyze the training effects. The performance of the bias training group was reliably better than that of both the incongruent bias group and the informed group. There was no advantage for the informed group over the incongruent bias group.

In summary, these results replicated the large effect of biases on task performance. Informing subjects that the descriptions were misleading did not improve their performance. However, performance did improve when subjects were first asked to describe the kind of object an individual might prefer if their assumptions were incorrect. The results of these studies support the validity of this type of induction task for studying practical reasoning.

#### Experiment 15: Sales Simulations

Most of the tacit knowledge measures we have produced require subjects to rate responses at their leisure. In everyday life, one must be able to use one's knowledge to respond in real time. Knowing what to do is not enough if one is not able to do it effectively. In this study we constructed a sales simulation. The subject pretended to be a salesperson and the experimenter a customer. The experimenter followed a script that portrayed various sales problems. Six scores were derived from subjects' responses, three of which are determined by what the examinee said (validate, counter, and probe), and three of which are determined by how the examinee said it (fluency, sincerity, enthusiasm).

**Fluency:** 2 points possible. Give 1 point if response is initiated within 2 seconds. Give 1 point for fluent response (i.e., no pauses, stumbling, "uhs").

**Sincerity:** Give 2 points for convincing sincerity; 1 point for some but not convincing sincerity; 0 points for little or no sincerity).

**Enthusiasm:** Give 2 points for convincing enthusiasm; 1 point for some but not convincing enthusiasm; 0 points for little or no enthusiasm).

Validating: Effective salespeople often acknowledge and/or reflect what the customer says. Give 2 points if a statement refers specifically to the customer's response.

Countering: Effective salespeople may counter a customer's objections rather than either accepting them or ignoring them. Give 2 points if a statement counters the customer's objection.

Probing: Effective salespeople often probe the customer for additional information relevant to making the sale. Give 2 points if a statement probes the customer.

The subjects were the same three groups used in the previous study. The test-retest reliability coefficients, presented in Table 4, indicate that there is sufficient test-retest reliability for each of the scores.

Standardized Cronbach's Alphas calculated for the three normative samples are presented in Table 5.

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Insert Table 5 about here

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Satisfactory internal consistency reliability was indicated for the Style Total and Overall Total Scores. The low internal consistency reliability for the Content Total Score indicates that different sales situations elicited different types of responses across subjects. This is an expected state of affairs rather than a cause for concern.

Satisfactory scorer reliability was indicated by percentage of agreement values of .93, .88, and .94, and Kappa values of .77, .69, and .84 for the three content scores, respectively.

Evidence of the discriminant validity of the inventory was obtained in two ways. The first was to examine the success with which the inventory could differentiate individuals who have sales experience from comparable individuals without sales experience; the second was to examine correlations between performance on the inventory and a measure of verbal reasoning ability to establish that the inventory was not simply a disguised IQ test.

Means and standard deviations of the inventory scores are presented for the three normative groups in Table 6.

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Insert Table 6 about here

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The results support the discriminant validity of the inventory. In general, the means of the salesperson group were reliably higher than those of the community and undergraduate groups, and the means of the community and undergraduate groups were comparable. One exception to this pattern of results was that the undergraduates were as fluent as the salespersons. Another exception was that the salespersons countered less than the other groups. When the six subtest scores were used to classify cases in a discriminant analysis, 92.1% of cases were correctly classified for salesperson and undergraduate samples, and 88.6% of cases were correctly classified for community and salesperson samples.

The undergraduate sample was given the DAT Verbal Reasoning subtest so that the correlation between verbal ability and tacit knowledge could be examined. The correlations between the Differential Aptitude Test and the inventory scores were not reliably different from zero for Style Total (.08), Content Total (.10), or Overall Total (.11) scores. This result, which also held for each of the six subtest scores, indicates that the inventory is not simply a fancy IQ test, but rather is measuring something other than general verbal ability.

Table 4

Test-retest reliability coefficients with a test-retest  
interval of one month

Score	Reliability Coefficient
Fluency	.65
Sincerity	.63
Enthusiasm	.66
STYLE TOTAL	.73
Validate	.52
Counter	.77
Probe	.52
CONTENT TOTAL	.61
OVERALL TOTAL	.71

Table 5

Standardized Coefficient Alpha Internal Consistency  
Reliability Coefficients

Score	Normative Sample		
	Undergraduate Community	Salesperson	
Style Total	.93	.84	.91
Content Total	.43	.38	.22
Overall Total	.87	.78	.85

Table 6

## Means (and Standard Deviations) of Inventory Scores

SCORE	COMMUNITY		SALESPERSON		UNDERGRADS	
Fluency	14.94	(0.92)	22.44	(4.65)	23.08	(5.01)
Sincerity	18.47	(3.44)	22.89	(4.17)	17.41	(3.91)
Enthusiasm	16.74	(2.53)	18.83	(3.70)	16.64	(4.52)
STYLE TOTAL	50.15	(5.52)	64.17	(10.87)	57.12	(9.97)
Validate	8.06	(4.61)	11.44	(6.70)	6.29	(2.74)
Counter	15.24	(4.65)	11.22	(4.15)	13.14	(5.90)
Probe	11.00	(4.27)	15.11	(4.04)	8.64	(4.16)
CONTENT TOTAL	34.29	(7.00)	37.78	(6.76)	28.07	(6.60)
OVERALL	84.44	(10.48)	101.94	(14.18)	85.19	(12.70)

### Experiment 16: Group intelligence

Our goal in this study was to investigate the characteristics of persons who work effectively in groups, as well as the characteristics of group interaction in more and less effective groups. Our assessment of these characteristics involved two approaches--self-report and observer-report. In past research, the evaluation of personality was based on standard self-report tests. We broadened the assessment of personality by including an observer's ratings of a subject's social-cognitive characteristics from videotapes of group interactions.

Subjects were 96 adults recruited through advertisement in a local newspaper, with equal numbers of males and females. All subjects were given two written problem situations, from marketing and from public policy issues, in 3 different conditions--working alone on both problems, working on one task alone and on one in a group, or working on both tasks in a group. In addition, every subject received a test of mental abilities, several personality questionnaires, and an adaptation of the Social Competence Nomination Form (Ford, 1982) to measure social-cognitive abilities. Groups consisted of three persons of the same gender.

Each product was scored on a 1 (low) to 9 (high) scale with respect to its excellence, creativity, persuasiveness, and practicality by an experimenter and an outside rater, both blind to the conditions under which the product was put together. The videotapes of group interactions were also evaluated, with each group member being evaluated for communication, dominance, likability, cooperativeness, creativity, persuasiveness, flexibility, and practicality.

The alpha reliability of the product ratings was excellent, ranging from .96 to .98. The intercorrelations of the 4 product ratings were also over .90, so the ratings were combined and averaged. The inter-rater reliability for the videotape assessments was also satisfactory.

Using a protected t-test comparing group and alone product quality, we found that group products were significantly better than individual products. Correlations of the cognitive measures (such as IQ, creativity, practicality, and persuasiveness) with group product quality were statistically significant. The best single predictor of quality was rated maximum creativity (creativity of the most creative member of the group), with a correlation of .81. Correlations of the social-cognitive measures (such as desire to participate, dominance, amount of communication) with group product quality were significant only in a few cases, most notably a negative correlation with the maximum desire to participate. In other words, if someone in the group was very eager to participate (what we called the "eager-beaver phenomenon"), group product quality tended to be worse.

The results support the hypothesis that, on the average, persons working in a newly-formed small group produce higher quality products than persons working alone. Furthermore, both cognitive and social-cognitive characteristics of group members are related to group performance, and both written and videotape-derived measures of these characteristics are valid predictors of group product quality. The best model of group effectiveness is based on the highest cognitive score in the group and the average of the group's social-cognitive scores. Group effectiveness was also enhanced by higher group motivation (as rated from the videotapes), higher minimum age, and smaller range in age. These results seem to indicate that internal harmony or agreement within the group leads to better performance.



### Conclusions

To summarize the first section, several main points emerged from our studies of adults.

First, the concept of tacit knowledge is important for understanding work performance in multiple domains, such as academic psychology, business management, sales, and even academic study. Second, tacit knowledge increases, on the average, with amount of experience in a domain, but it is what is learned from experience, not the experience itself, that matters. There can be wide individual differences within groups of comparable levels of experience. Third, tacit-knowledge scores correlate poorly, if at all, with conventional ability-test scores, at least within the ranges of subjects we tested. It is important to remember, though, that the people who actually go into the occupations we studied do not represent the full range of possible intelligence-test scores, but rather a truncated and above-average range. Fourth, tacit knowledge is not a proxy for conventional measures of personality either. Fifth, tacit-knowledge scores correlate moderately with each other and with external performance criteria. One apparently can predict tacit knowledge in one area from tacit knowledge in another, and one can obtain moderate prediction to external criteria of success. Of course, these criteria are ones that are defined by the field as a whole, and do not necessarily correspond to the criteria of success of a given individual. Sixth, the knowledge-acquisition components of selective encoding and selective combination, and probably selective comparison, are important to the acquisition of tacit knowledge. Seventh, tacit knowledge, and its associated rules of thumb, are by no means all that matter for job performance. We need to go beyond conventional tests to understand what else does matter.

In sum, our studies show that tacit knowledge is important to success, and is not merely a fancy proxy for IQ. The goal of ability testing has always been to assess a person's ability to adjust in the world, not only the world of school, but also the world of work. Testing tacit knowledge provides a unique entree into assessing adjustments of both kinds.

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